Between Both Worlds
4 years of a joint PhD

Moritz Müller| NetSys PhD Forum

16 September 2021

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2017: Where it all began

2017: PhD! But how and where?

2017: Let's get started!

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2017: The long and winding road to the Root Rollover paper

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2017: The long and winding road to the Root Rollover paper

2018: The long and winding road to the Root Rollover paper

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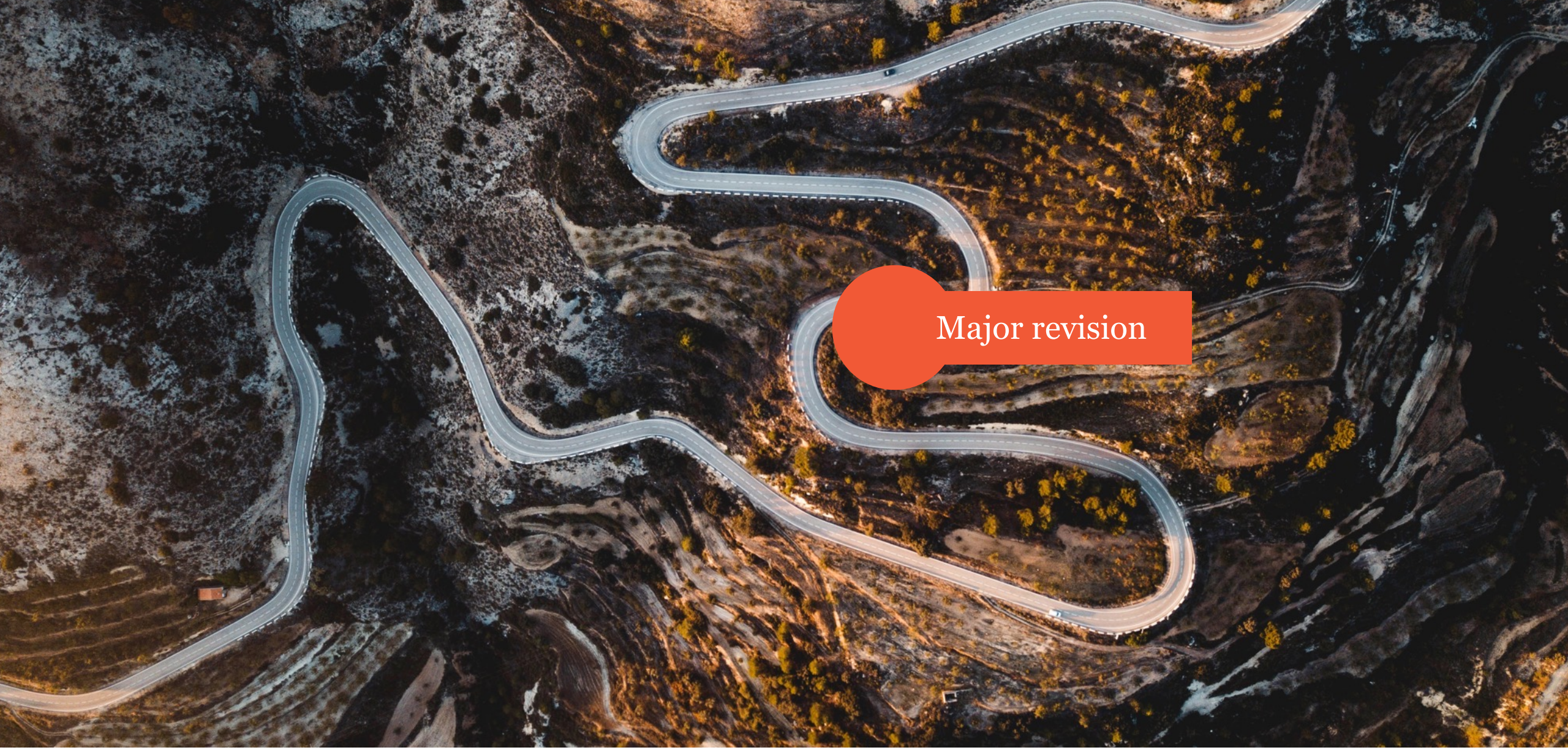

2019: The long and winding road to the Root Rollover paper

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2019: The long and winding road to the Root Rollover paper

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2018: A few steps back on the road to the Root Rollover paper

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Working in a team

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2019: Finally arrived

2020

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Photo by Drew Coffman

2020

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2020: DNSSEC it is

The Reality of Algorithm Agility: Studying the DNSSEC Algorithm Life-Cycle

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ABSTRACT

The DNS Security Extensions (DNSSEC) add data origin authentication and data integrity to the Domain Name System (DNS), the naming system of the Internet. With DNSSEC, signatures are added to the information provided in the DNS using public key cryptography. Advances in both cryptography and cryptanalysis make it necessary to deploy new algorithms in DNSSEC, as well as deprecate those with weakened security. If this process is *easy*, then the protocol has achieved what the IETF terms "*algorithm agility*". In this paper, we study the lifetime of algorithms for DNSSEC. This includes: (i) standardizing the algorithm, (ii) implementing support in DNS software, (iii) deploying new algorithms at domains and recursive resolvers, and (iv) replacing deprecated algorithms. Using data from more than 6.7 million signed domains and over 10,000 vantage points in the DNS, combined with qualitative studies, we show that DNSSEC has only partially achieved algorithm agility. Standardizing new algorithms and deprecating insecure ones can take years. We highlight the main barriers for getting new algorithms deployed, but also discuss success factors. This study provides key insights to take into account when new algorithms are introduced, for example when the Internet must transition to quantum-safe public key cryptography.

When DNSSEC was standardized, operators had the choice of just three algorithms to sign their domains with. Over the past 15 years, 9 new algorithms were added and 5 were deprecated [69]. New algorithms can replace insecure algorithms, or have more attractive attributes, like smaller keys and signatures. *Algorithm agility* has been achieved, if this replacement can be carried out *easily*, according to RFC 7696 [27].

As in other Internet protocols, algorithm agility in DNSSEC is crucial, because we do not know how fast attacks on cryptographic algorithms evolve, only that, at some point, algorithms will be broken [27]. This becomes even more urgent with the rise of quantum computers [8]. Even though it is still not clear, *when* quantum computers will become generally available, they do have the potential to break *all* current algorithms used in DNSSEC. Then, it becomes crucial to replace vulnerable algorithms by *quantum-safe* algorithms easily and fast.

In DNSSEC, introducing new algorithms and replacing existing ones is a four-stage process and we explain it in more detail in Section 2.2: (1) standardization at the Internet Engineering Task Force (IETF), (2) implementation in software and at entities responsible for registering and publishing domain names, (3) deploying algorithms at domain names and rolling out validating resolvers, and (4) deprecating insecure algorithms.

2020: DNSSEC it is

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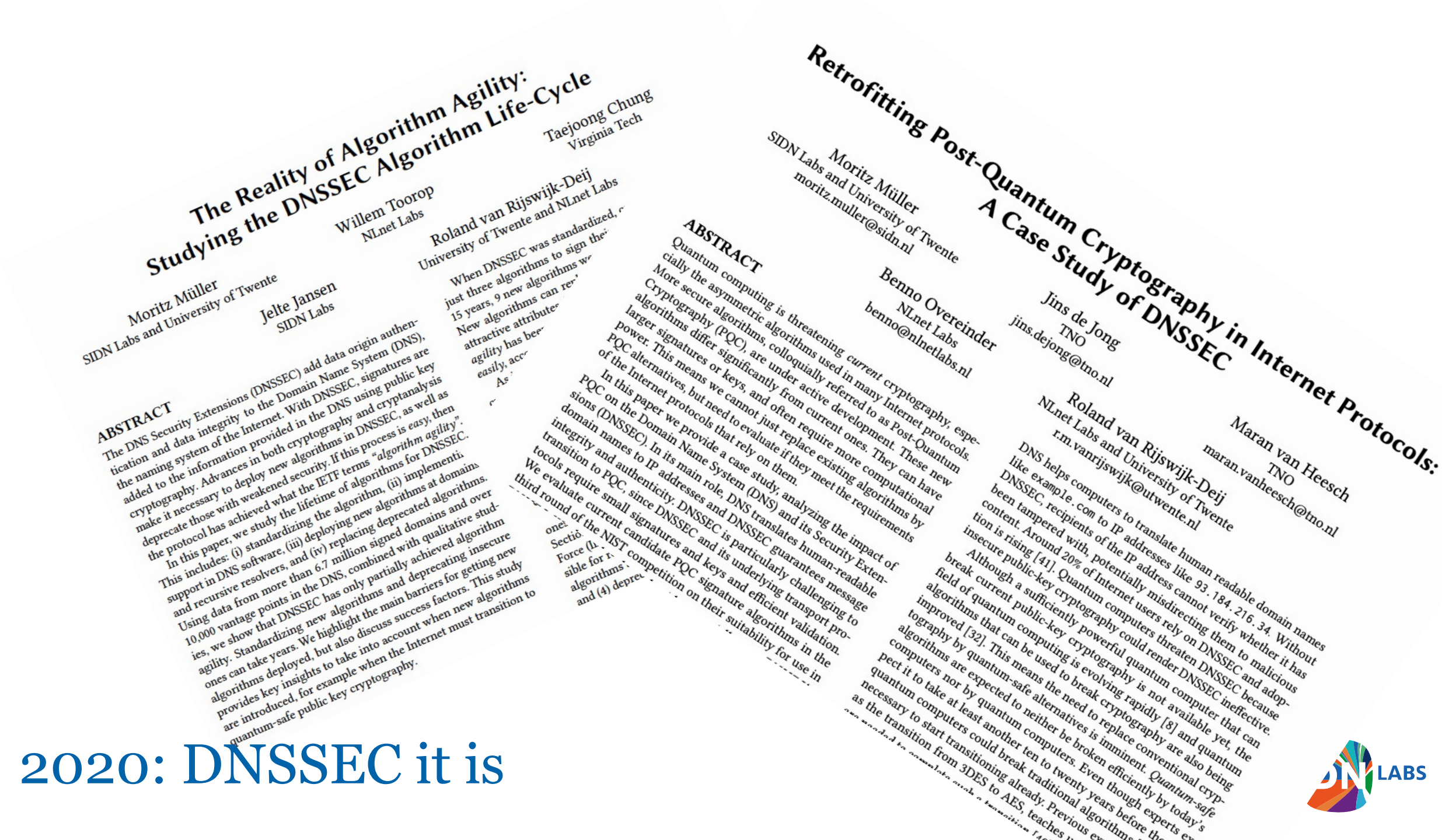
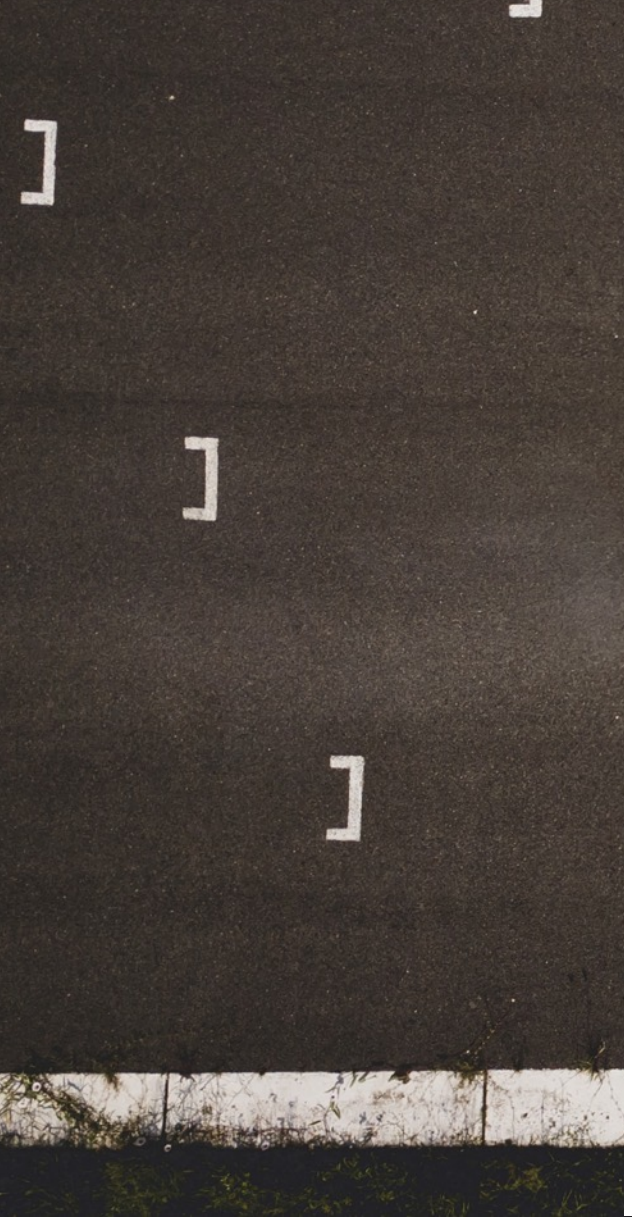


2020: DNSSEC it is



Wrapping things up

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Photo by Anton Shuvalov

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Questions? Comments?